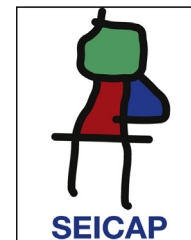




Allergologia et immunopathologia

Sociedad Española de Inmunología Clínica,
Alergología y Asma Pediátrica

www.elsevier.es/ai



ORIGINAL ARTICLE

Asthma exacerbation in children: Relationship among pollens, weather, and air pollution

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Received 3 January 2013; accepted 26 February 2013

Available online 4 June 2013

KEYWORDS

Air pollution;
Asthma;
Children;
Emergency calls;
Exacerbations;
Meteorological
parameters;
Pollens

Abstract

Background: Asthma exacerbation is an episode of (sub)acute worsening of asthmatic symptoms. Exacerbation may depend on environmental factors.

Objective: The present study investigated emergency calls for asthma exacerbation in children, analysing: i) their trend over the course of time; and ii) their possible relationship with environmental factors, including pollen count, meteorological parameters, and air pollution.

Methods: Emergency calls for exacerbation were recorded for 10 years (from 2002 to 2011) in Genoa (Italy). Betulaceae, Urticaceae, Gramineae, and Oleaceae pollen counts were measured. Meteorological parameters and air pollutants were also measured in the same area and for the same period.

Results: The number of emergency calls did not significantly modify during the time studied. Two main peaks were detected: during the autumn and the spring. Wind speed significantly diminished as did most air pollutants. There were significant and relevant relationships between emergency calls and: pollens during the spring ($r=0.498$), rainfall ($r=0.818$), wind speed ($r=0.727$), and air pollutants ($r=0.622$ for SO_2 ; $r=0.699$ for NO ; $r=0.58$ for NO_2).

Conclusions: This 10-year survey demonstrates that: (i) asthma exacerbations did not diminish over the time; (ii) there were seasonal peaks (autumn and spring); (iii) pollens (mainly Parietaria), wind speed and rainfall, SO_2 , NO , O_3 and NO_2 were strongly associated with asthma exacerbations in children in this area. Therefore, asthma exacerbations may significantly depend on environmental variations.

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Introduction

Despite advances in asthma management, asthma exacerbations continue to occur and the frequency varies depending on the severity and the degree of control.¹ The most comprehensive data on exacerbation incidence derive from therapeutic clinical trials: asthmatics receiving optimum treatment should only have one exacerbation every three years.² However, these clinical trials do not reflect the real exacerbation rates, as they are conducted in optimal conditions both for patients' characteristics and methodology. For example, a survey analysing reports of US emergency departments demonstrated that 73% of patients had had at least one visit for asthma exacerbation in the previous year.³

Asthma is the most common chronic disease among children.⁴ Its prevalence is up to 10% of the general paediatric population in Europe.⁵ Asthma is a public health problem that is under-diagnosed and under-treated. It causes a substantial burden to children and their families and often restricts children's activities and school performance. In addition, having an asthma exacerbation is one of the most distressing events in childhood asthma.⁶ Asthma exacerbation is an episode of (sub)acute worsening of asthmatic symptoms.⁷ The majority of asthma exacerbations are usually preceded by viral upper airway infections.⁸ Other exacerbation triggers are also: allergen exposure, weather conditions, and air pollutants.⁹ However, an accepted and univocal definition of asthma exacerbation is still debated. Two types of definition have been proposed: conceptual (precise descriptions of the meaning of a word) and operational (describing the presence or quantity of defined objects by derivable properties). The common denominator is a deterioration of symptoms, and three different ways to define an exacerbation can be considered: increased symptom severity, fall in lung function parameters, and healthcare utilisation.⁷ To propose asthma definition, assessment, and standardisation, National Institutes of Health and federal agencies recently convened an expert group.¹⁰ The proposed definition of asthma exacerbation is a worsening of asthma requiring the use of systemic corticosteroids to prevent a serious outcome.¹⁰ Healthcare utilisation represents a relevant component in exacerbation outcomes.

Recently, a study has been carried out in order to evaluate the medical emergency calls requiring attention for asthma exacerbations among the population of the territory of Genoa (Italy) in an eight-year period.¹¹ This survey reported that the frequency of asthma exacerbations in children did not diminish over time. More recently, the collection of pollen counts, weather and pollutants records concerning the last 30 years in the same city was analysed.¹² This study provided evidence that some sensitisation significantly increased, pollen counts exerted a higher pressure, and climate and pollution changed, very probably influencing pollen release. On the other hand, there is no study on this issue that has been conducted for a long period.

For these reasons, the present study aimed at evaluating the trend of medical emergency calls for asthma exacerbations in children, also collecting pollen count, weather, and air pollutants records during the period 2002–2011

in the Genoa (Italy) area. The purposes were: (i) to evaluate the time trend, and (ii) to detect a possible relationship among the clinical phenomena, such as asthma exacerbations, pollen count, meteorological data, and air pollution.

Materials and methods

The territory of Genoa has a population of about one million of inhabitants. Genoa is a port city situated on the Mediterranean Sea (20 m above sea level, latitude 44°25'N and longitude 8°56'E), is in the north-west of Italy, and has a temperate climate.

Clinical data

The clinical data were provided by the records of the 118 Medical Emergency Control Center of Genoa, in its capacity as a body officially coordinating all medical emergencies by telephone. The medical staff code all incoming calls as per the International Classification of Diseases, 9th Revision (ICD-9). The San Martino Hospital's Ethics Committee has approved this study procedure. The data were analysed both considering the years and months of incidence, in children (0–17 years) and were regularly recorded between January 1, 2002, and December 31, 2011.

Pollen data

Aerobiological data regarding pollination period were assessed, and pollen concentrations recorded in the same period. The monitoring of pollens was performed at the survey centre of San Martino Hospital concerning the first two decades, then data were collected by ARPAL (Agenzia Regionale per la Protezione dell'Ambiente Ligure), according to standard methods of the Italian Aerobiology Association (AIA), now also recognised as: UNI 11108. Airborne pollens were collected using a Burkard seven-day-recording volumetric spore trap, standard equipment used for aerobiological sampling worldwide. This spore trap was placed 20 m above ground level and away from sources of pollution. The choice of pollen species was based upon two criteria: (i) they had to be the most important pollen types causing sensitisations and allergic symptoms in the people living in this geographic area; and (ii) they had to be present in the atmosphere, every year, in relatively high or significant concentrations. For these reasons, four pollen species were measured: Gramineae, Betulaceae, Urticaceae, and Oleaceae.

Gramineae included *Phleum p*, *Dactylis g*, *Poa a*, *Lolium s*, and *Festuca e*. Betulaceae included *Betula alba*, *Alnus*, and *Corylaceae* (such as *Corylus a.* and *Carpinus a.*) were added. Urticaceae included *Parietaria judaica* and *Parietaria officinalis*. Oleaceae included olive tree.

For each taxon, 52 mean weekly pollen concentration values and peaks (grains/m³ air) were recorded and the sum of 52 weekly pollen concentration values gave an estimate of the annual amount of each pollen species. These four major allergenic species (Betulaceae, Gramineae, Oleaceae

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